Nick Crispie
Team C: FlySense
IRL01
10/13/17

Individual Progress

For my contribution to the Sensors and motors lab, I programmed and wired the analog force sensor and programmed the stepper motor. In addition, I soldered the DC motor controller, and worked on hardware and software integration.

Force Sensor

The force sensor we used was acted as a variable resistor, changing the resistance across it as it deforms due to force applied. The force sensor is set up in a voltage divider circuit with one end attached to a logic supply voltage (5V in our case) and the other end attached to an analog read pin on the arduino and a 10K resistor attached to ground (Figure 1). This allowed us to measure the voltage across the sensor as the resistance changes due to changes in force.

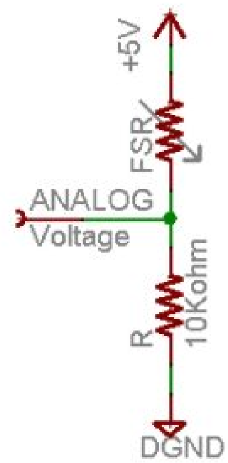

Figure 1: Circuit diagram for the Force Sensor

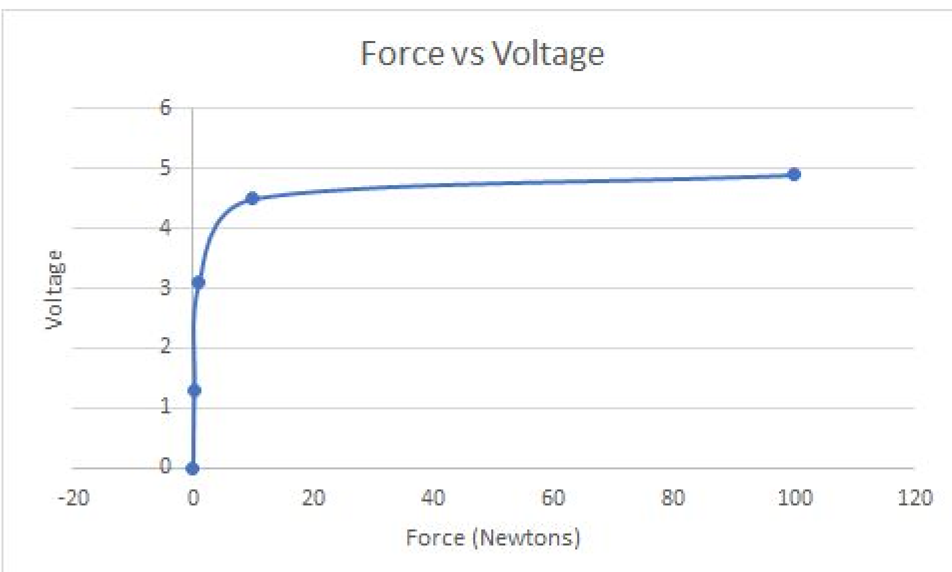

Figure 2: Sensor Calibration Data provided by supplier

The sensor itself came with a calibration curve, and recommended conversion transfer function, which we used in the absence of calibrated weights to test the accuracy and in given the limits of time during the lab. If we were to confirm the readings, we would get a set of known weights and measure the resultant voltage from that to develop our own curve for the force sensor.

Stepper Motor
The stepper motor used was a Mercury SM-42BYG011-25 motor using a Pololu md20b stepper motor driver. The stepper motor has steps of 1.8 degrees each, and microsteps of .45 degrees. In order to control the stepper motor, I first got the force reading from the force sensor in meters and mapped that first to a desired stepper motor angle, which in turn was mapped to the correct number of steps needed for the motor (as dictated by the number of degrees per step).

Hardware integration
I also assisted with the hardware integration, going over all of the wiring and making it neater for easier debugging as we added each sensor and motor circuitry (shown in Figure 3).

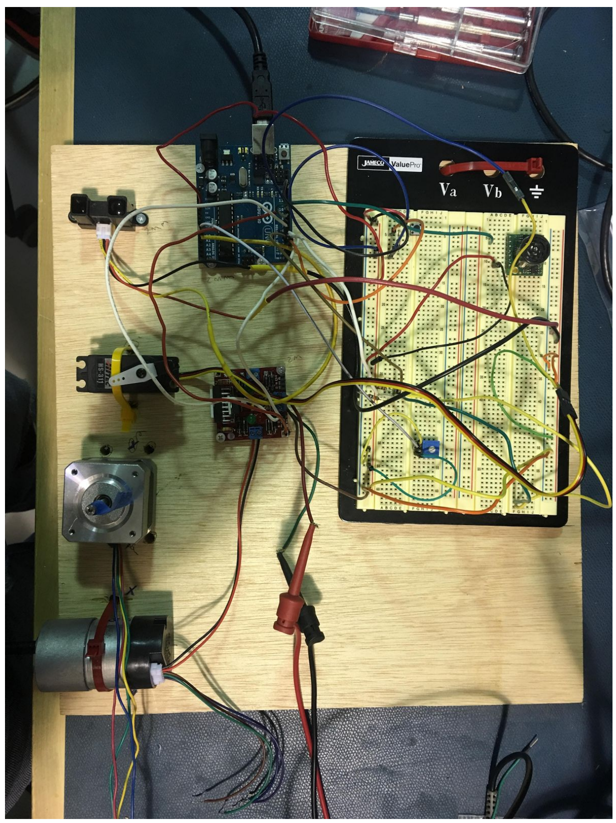

Figure 3: Final integrated hardware

Challenges
The biggest challenge I faced individually was trouble with bad hardware for the stepper motor. After building up the circuit for the stepper motor and testing exhaustively, I realized that the stepper driver that I was given was broken. I started developing the basic code with a driver that I borrowed from another

group until I could get a new stepper driver from a TA. After obtaining the new stepper driver, I did not have any further hardware issues.

I also helped with the challenges of integrating the code into the main program, which ended up being relatively straightforward since I organized the code with variables that could be easily manipulated or transmitted for use with the GUI, reducing the integration time.

Teamwork

Nick Crispie: I worked on the Force sensor and stepper motor. I also integrated the circuitry and helped with the mechanical and software integration, as well as the PID tuning.

Shivang Baveja: Worked on the ultrasonic sensor, DC motor position and velocity control, and led the software integration

Nihar Tanichetty: Worked on the GUI and software integration

Hari Suresh: Worked on the IR distance sensor and servo motor, and helped with mechanical and software integration.

Joao Fonseca: Did hardware integration and helped with GUI development.

Overall, the delegation of work was effective, with the one caveat that it would have been better to get all the component pieces the the lead integrator (Shivang) earlier to work out issues sooner.

Project Status and Plan

In our work so far, we have built relationships with our key stakeholders and begun to develop our key technological areas. We conducted a set of interviews with helicopter pilots at NEA and interviewed a set of search and rescue helicopter pilots to get an understanding of criteria for the user interface. We have also started testing with a Microsoft Hololens AR interface for the development of our UI. Moreover, we have developed mockups of the user interface and had meetings with experts in HRI for developing strategies for interfacing with the system.

Additionally, we have begun to investigate mapping of the environment with a Velodyne LIDAR from the lab and also started work on processing data and generating visualizations from LIDAR provided by NEA.

In the short term, we have plans to produce visuals from the NEA data and develop a method for filtering and processing the data and in parallel work more on a rudimentary AR interface for the product.